Attachment A – HCFA IT Vision

<u>HCFA's</u>

<u>Information Technology</u>

<u>Vision</u>

7/30/98

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Preface

In the early 1990's, HCFA began a major system development initiative to reengineer and consolidate its Medicare claims processing systems. The goals of the "Medicare Transaction Systems (MTS)" initiative were to improve service to beneficiaries, to achieve operational efficiencies through standardization, to improve payment safeguards, and to improve control over program expenditures. Because of a lack of satisfactory progress despite substantial effort and investment, HCFA made the decision in August 1997 to discontinue the initiative in January 1998 upon the completion of requirements development for the first segment of the system.

At the same time, HCFA began a reassessment of the objectives and the development strategy for a system to support Medicare, this time in the *enterprise-wide* context of HCFA's mission and business functions. This assessment reconfirmed the original objectives of the MTS initiative, but also acknowledged that, over the years since the MTS effort was initiated, the focus of HCFA's principal programmatic business drivers had shifted dramatically. Where once HCFA's primary focus had been on program operations (in the Medicare context, for example, the focus was on Medicare contractors and payments), the agency was becoming increasingly focused on desired program outcomes. These outcomes are realized by HCFA's customers (e.g., beneficiaries, researchers, legislators, and the public) and are reliant on accurate and timely information. The core focus of MTS was on Medicare business processes, specifically the payment of Medicare fee-for-service claims and payments to managed care plans. While data management and dissemination would be supported by MTS, they were secondary to the transaction/payment functions of the system. By contrast, the vision described in this document starts with data management as its core process. All operational business functions are viewed as operations on that data to achieve/support the desired program outcomes.

This document presents a contextual framework or vision for future IT investment at HCFA. It does not represent a specific system design as MTS did, nor is it a system development project, as MTS was. It does not recommend the replacement of the current Part A, Part B, DMERC and managed care systems with a single system, as MTS did, but provides an environment in which existing systems can work more effectively by sharing information, and in which they can be more responsive to the demands of changing business needs and the promises of emerging technology.

In developing this vision, HCFA brought together many of the insights gained from the MTS project and from the analysis that followed. Among these were the recognition that system development initiatives must be broken into relatively small, manageable modules in order to be effectively monitored and controlled, and that close adherence to a set of standards would be necessary to ensure that these systems modules would fit together seamlessly. This vision statement is the foundation upon which HCFA will begin the development of a target IT architecture. An IT Architect was appointed in January 1998 to manage the development and implementation of the architecture. The target architecture and a migration plan are scheduled for completion by FY99.

HCFA's Information Technology Vision

Introduction

The Health Care Financing Administration (HCFA) was created in 1977 to bring together the two largest Federal health care programs under one leadership. In the 20 years since, HCFA's mission has grown beyond the Medicare and Medicaid programs to include responsibility for additional programs such as Federal oversight of clinical laboratories under the Clinical Laboratory Improvement Act, for individual and small group health insurance regulation under the Health Insurance Portability and Accountability Act, and for the Children's Health Insurance Program under the Balanced Budget Act of 1997. HCFA is the largest purchaser of health care in the United States, serving 72 million Medicare and Medicaid beneficiaries. Six million of these beneficiaries are served by both of these programs. HCFA employs about 4,000 staff in locations around the country; these include physicians, nurses, other health professionals; statisticians; actuaries; specialists in financial management, information systems, public information, laws, and regulations; and experts in many other fields. Through the Medicare and Medicaid programs, more than $430 billion in entitlement funds is expended annually for health care services and products for beneficiaries.

In 1996, HCFA embarked on a major reorganization effort, which began with extensive analysis and wide consultation on the roles HCFA should undertake over the next 5 to 10 years. Out of this process came a clarified sense of HCFA's mission and vision for the future:

HCFA's Mission: **To assure health care security for beneficiaries.**

Health care security means:
- Access to quality health care services which are affordable to beneficiaries;
- Protection of the rights and dignity of beneficiaries; and,
- Provision of clear and useful information to beneficiaries and providers to assist them in making health care decisions.

HCFA's Vision: **In its stewardship of the Medicare and Medicaid programs, HCFA leads the Nation's health care system toward improved health for all.**

The Vision reflects HCFA's commitment to:
- Strive toward the best possible health outcomes for Medicare and Medicaid beneficiaries, in cooperation with States and other partners;
- Purchase health care for our beneficiaries that represents "best value" - high quality care at the best possible price; and,
- Use market presence as the Nation's largest purchaser of health care to promote continuous improvement in both quality and value throughout the health care system.

HCFA Business Needs

Information Technology (IT) is one of the primary tools that HCFA uses to meet its business needs. IT should be both a facilitator, making HCFA operations more efficient, and an enabler, allowing HCFA to develop new ways to effect better health outcomes for its beneficiaries. Before discussing how IT can fulfill these two roles, we need to examine HCFA's business needs. HCFA's current strategic plan elaborates three major business drivers that shape HCFA's information resource needs: Program Administration, Customer Service, and Quality of Care. A central theme of the strategic plan is moving the agency towards becoming a "beneficiary-centered purchaser" of health care services. This movement expands HCFA's role beyond its traditional regulatory and claims payment focus into one which places greater emphasis on assuring that health care expenditures are warranted, prudent, and supportive of the overarching goal of providing quality care for beneficiaries at reasonable and proper cost.

HCFA is really a collection of businesses. HCFA is not just a Government agency; it is also a social insurance company, a financial institution, a contract administrator and, increasingly, an information services provider.

HCFA needs to aggressively respond and adapt to the restructuring of traditional health care delivery systems and the organizations that support and control them. Increased emphasis on profitability in the health care marketplace must be balanced by improved measures of quality of care and increased attention to health care outcomes, so as to ensure that reduction in service costs do not imperil the delivered quality of care or the overall health of the beneficiary population.

HCFA does not directly deliver health care services, but rather deals with the policies that govern what services or products are covered, the management of the delivery, and ultimately the payment for health care products and services. HCFA’s business functions are concentrated in the following areas of responsibility:

Identification and Enrollment

- of entitled beneficiary populations
- of health care professionals authorized to provide services

Transaction Processing

- of beneficiary enrollment, disenrollment, status changes
- of coordination of benefits
- of claims processing (editing, pricing, payment) and recording
- of provider enrollment, disenrollment, status changes
- of provider cost reporting

Customer Service

- consumer information
- system of rights protections

Surveillance/Profiling

- of fraud and abuse
- of epidemiological data used to identify opportunities to improve health care quality
- of customer service patterns and improvement

Regulation

- of health and safety standards for providers
- of clinical laboratories
- of data standards for the health care community

Research and Development

- health economics analysis
- health services research
- population analysis

Pricing and Actuarial Analysis

- service and capitation pricing
- Trust Fund management

All of these activities integrally depend upon information and decision-making based upon that information. HCFA is a very information-dependent organization; its primary business role is the collection, distribution, and analysis of information, and then making informed decisions based upon those analyses, where those decisions include everything from certifying eligibility to correct claims payment to determination of policy to assessment of health care outcomes.

Our focus in this document is on how the business role of information management can best be performed by HCFA, remembering always that the ultimate goal of HCFA's programs is the efficient delivery of effective health care services to our beneficiaries.

HCFA's business operations need to perform at or better than current industry standard. In particular, the following are critical areas where information technology plays a role:

Efficiency: Business operations such as claims processing and data analysis must focus on optimizing value for expenditures.

Effectiveness: Program effectiveness is a measure of outcomes. For HCFA the key outcome is improved health care for its beneficiaries.

Program Integrity:	Vigilance against fraud and abuse is a core responsibility for programs using public funds.
Security:	Program operations must ensure that privacy information entrusted to HCFA is properly protected and managed against loss or corruption, and that processes and corporate assets are protected against damage or unauthorized use.
Continuity of Service:	Disruption of service affects the interests of HCFA's beneficiaries and providers. Mediation of risk through careful planning and prudent program and project management is a key IT responsibility.
Accessibility:	Customers and beneficiaries require prompt access to information--increasing the breadth and quality of delivery mechanisms improves accessibility.

Information Technology Strategic Vision

Organizations employ IT to enable the management and flow of information in support of business needs. IT provides the tools for storage, access, movement, manipulation, and display of information, so that appropriate decisions can be made promptly and accurately. Some, but not all, decision-making can be automated, so one focus of the IT effort is to automate those rote and routine processes that can be automated, reserving human decision-making for the most complex and demanding tasks. Simply, the goal of information technology is to leverage human activity.

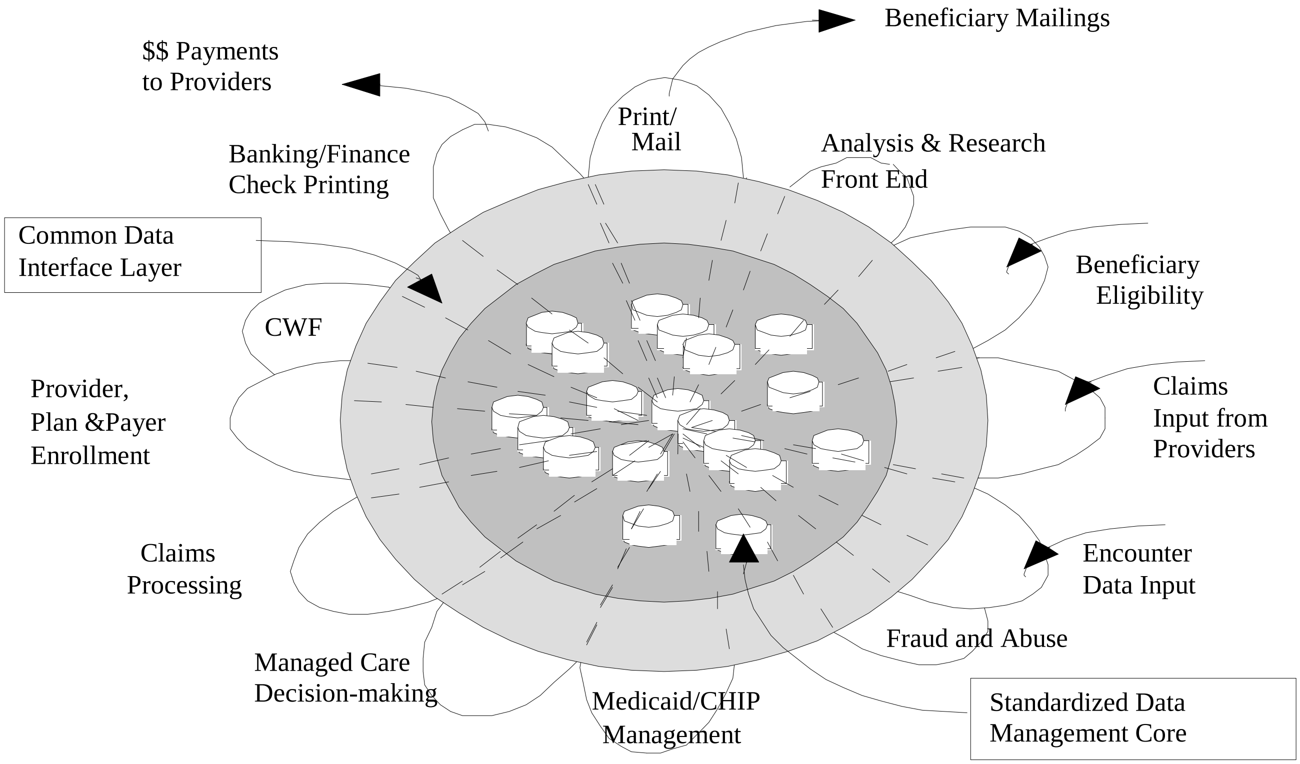
Congress recognized the importance of taking a strategic approach to Government IT in the Clinger-Cohen Act. OMB has supplemented the statute with focussed guidance on a variety of IT-related topics. HCFA has responded to this environmental sea change by establishing a CIO position during its 1997 reorganization and implementing IT investment review procedures which internalize the so-called Raines' rules. Further, HCFA established a Systems Architect position reporting to the CIO and awarded a series of blanket purchase agreement contracts for professional systems integration services. These steps position HCFA to deal effectively with the many challenges it faces in acquiring and deploying IT to support HCFA's complex and evolving mission.

To promote the health of our beneficiaries we wish to minimize administrative barriers to the delivery of health care while maintaining adequate oversight and control to ensure that the dollars are well spent. This means that queries to stored information, namely, the determinations of eligibility of beneficiaries and of providers, determinations of the validity of claims, and decisions on payments need to be performed very rapidly to avoid delaying actual delivery of care. If health care providers do not promptly receive payment, for example, we induce providers to remove themselves from the program, potentially denying beneficiaries needed care. The highest volume business process that HCFA carries out involves the processing and payment of claims filed on behalf of beneficiaries by providers. A major IT challenge is to process and pay claims both rapidly and accurately when the data volumes are immense. As there is substantial structure to the claim process, this function is typified in IT terms as an On-Line Transaction Processing (OLTP) function, which is fundamentally similar to, but far more complex than, processing credit card transactions.

Another significant function of HCFA relates to maintaining and providing health care information for decision-making. The advent of managed care and the structural changes in the health care industry away from traditional fee-for-service introduce new IT challenges, such as the collection of encounter data, assessment of quality of care outcomes, and direct information distribution to beneficiaries. As a Federal agency, HCFA also has several other kinds of information customers, who have a need for and a right to information on HCFA's processes and procedures, and to access its data. These customers include oversight bodies such as Congress, the Office of Management and Budget, the General Accounting Office and the Office of the Inspector General; internal data customers and policy-makers in HCFA components; and external data customers including researchers and FOIA requesters. Although these information needs do not have the same time sensitivity or volume demands as claims processing, the information requests are more complex and less structured. This means that these data queries are more general, less easily automated, and require more resources per request. In IT terms, such query functions are termed On-Line Analytical Processing, or OLAP.

Our IT vision must accommodate and address the needs of both these important functions. The IT architecture, namely the combination of software systems, hardware platforms, and communications linkages, must not only handle current business needs, but must also provide the inherent capability to smoothly expand to address future volume needs, to seamlessly adopt new and more efficient technologies as they develop, and to readily support the administration of new programs.

Our IT vision thus starts with data management as the core process. All operational business functions can be seen as data operations, whether the function is claims processing, financial audits, or research queries. By optimizing information management we improve the efficiency of all processes dependent on information flow. This optimization depends upon structuring the data so that searches through the data are rapid, and upon structuring the interfaces to the data so that communication of data to and from business functions is efficient and well defined. This information-centric vision, visualized by a "sunflower" model, shown in Figure 1, encompasses the IT needs of all of HCFA's programs.



Sunflower Model for the Information-Centric IT Architecture

Figure 1. Information-Centric Vision of Future HCFA Information Architecture. Individual business functions are supported by specialized systems represented by the petals. Primary database management occurs in the core; all databases are readily accessible to all business functions through standard interfaces. The use of standard interfaces allows functions to be easily altered, added, or removed without affecting other operations. Compare this model to the Business System-Oriented Architecture of Figure 2. Note that this picture is a logical functional model and does not presuppose physical co-location of functional elements. The specialized business systems shown in this picture are a subset of the many programmatic and administrative systems extant at HCFA. Many more petals would be needed to make this a comprehensive model of the enterprise.

The Information-Centric Vision addresses HCFA's current and future needs as follows:

Program Management Needs

Increased Efficiency:

Integrating data used by all business processes does the following:

- Replicate database management structures are consolidated and require less staff support.
- Elimination of replicate data reduces overall storage needs and costs.
- Synchronization problems between different copies of the same data in different business functions disappear, eliminating costly exception handling due to data discrepancies.
- Consolidation of similar data input/output functions from different business systems reduces system maintenance costs and provides greater system stability and reliability.
- Economies of scale result from use of common platforms as database servers.
- Reduction in size of business function systems results in decreased testing and maintenance costs as complexity decreases.

Using standardized interfaces does the following:

- Subsystems that perform different business functions become smaller, more modular, and easier to maintain and modify, which translates into decreased life cycle costs.
- Addition of new business functions is simplified because the functions build upon existing services; new subsystems are smaller and thus faster and cheaper to build, test, and maintain.

Increased Effectiveness:

Integrating existing data used by all business processes does the following:

- Pre-payment detection of fraud, waste, and abuse is facilitated.
- Costly investigations are focussed due to more accurate targeting of suspicious claim behavior.
- Data integration improves post-payment analysis of health care outcomes leading to enhanced policy development.
- Financial data can be more readily analyzed to support program management, detect operational inefficiencies, and perform reliable cost-benefit analysis.
- As data becomes more readily accessible, and more used, the quality of the data is improved, leading in the long term to more accurate decisions and more effective programs.

Using standardized interfaces does the following:

- Electronic data exchanges in support of claims adjudication permit, for example, resolution of suspended claims by automated requests for structured supplemental data directly from providers' information systems. This substantially leverages the efforts of medical reviewers.

Increased Security:

Integrating data used by all business processes does the following:

- Risks of disclosure or corruption of privacy information can be more effectively addressed when data is under centralized control, and when there are fewer copies of the data to protect.
- Security policies are easier and cheaper to enforce.
- Risks to processes and resources are more readily addressed in an integrated environment.

Using standardized interfaces does the following:

- More structured interfaces vastly simplify detection of illicit and illegal behavior.

Continuity of Service:

Integrating data used by all business processes does the following:

- Contingency and disaster planning are vastly simplified.
- Increased security lessens threats of disruption of processing by illicit activity.
- Operational stability is enhanced and system reliability is increased whenever systems are made less complex.

Using standardized interfaces does the following:

- Risks and problems in transitioning workloads between contractors decrease with increased standardization.

Customer Service Needs

Accuracy of Responses to Information Requests:

Integrating data used by all business processes does the following:

- Improved synchronization of data enhances the accuracy of data responses.
- Where data queries are filled promptly, outdated information is significantly minimized.
- Eliminating replication improves data consistency and accuracy.

Timeliness of Responses to Information Requests:

Integrating data used by all business processes does the following:
- Responses are more timely when the data is all accessible in one logical location.

Using standardized interfaces does the following:
- Standardized interfaces allow staff to build ad hoc queries from their desktops, instead of requesting programmers to develop specialized reports; response times drop dramatically.

Completeness of Responses to Information Requests:

Integrating data used by all business processes does the following:
- Responses requiring data from multiple sources tend to be incomplete when the data is not all accessible simultaneously; an integrated data store provides completeness by definition.
- Data collated from separate sources often contain inconsistencies that cannot be reconciled by the requester; such inconsistencies are eliminated by data integration, making responses more reliably complete.

Quality of Care Needs

Maintenance of Quality of Care Levels:

Integrating data used by all business processes does the following:
- Historic data can be effectively mined for outcomes and quality assessments when the data is integrated and readily accessible to program managers and policy-makers. Such baseline outcome information is critical in determining whether levels of care are maintained at current levels by new service providers (e.g., managed care).
- Integrated data makes possible comparative studies of the value of outcome indicators, e.g., encounter data, relative to prior collected data, in time frames short enough to affect policy decisions and allow proactive program management to prevent degradation of beneficiary health.

Improvement of Beneficiary Health:

Integrating data used by all business processes does the following:

- Integrated data makes possible new policies, based upon statistical outcomes and epidemiological studies not previously practical, that can improve health outcomes.
- More efficient operations yield programmatic savings that can be spent profitably on outreach and educational programs that can lead to better use of health care benefits by beneficiaries.

In summary, by creating centralized, standardized data stores, HCFA can ensure reliable and consistent results each time the data are accessed. This structure allows for increased understanding of the data by its users since there is a single source of the data elements as well as a comprehensive definition of the origin, meaning and uses of each data element. Additionally, a single store will allow for quick problem recognition, quick resolution of data errors, and the identification and explication of data anomalies.

While for simplicity the discussion in the following sections is focussed primarily on the Medicare business processes and systems, similar cases can be made for HCFA's other program and administrative systems.

Business Origins of HCFA's Legacy Architecture

HCFA's current IT architecture is a classic "legacy" operation, or worse, a collection of over 100 "legacy" operations, some of which are depicted by the “stovepipes” of Figure 2. By "legacy", we mean that the information systems, both software and hardware, still clearly reflect business and system design philosophies of an era when, for example, claims processing was largely a paper-handling function. At the time these systems were designed, automation was seen a means of doing the same manual tasks, just more efficiently. To understand why HCFA's IT infrastructure has remained "legacy,” one must understand the historical forces that shaped it, and these are the forces which still impede modernization.

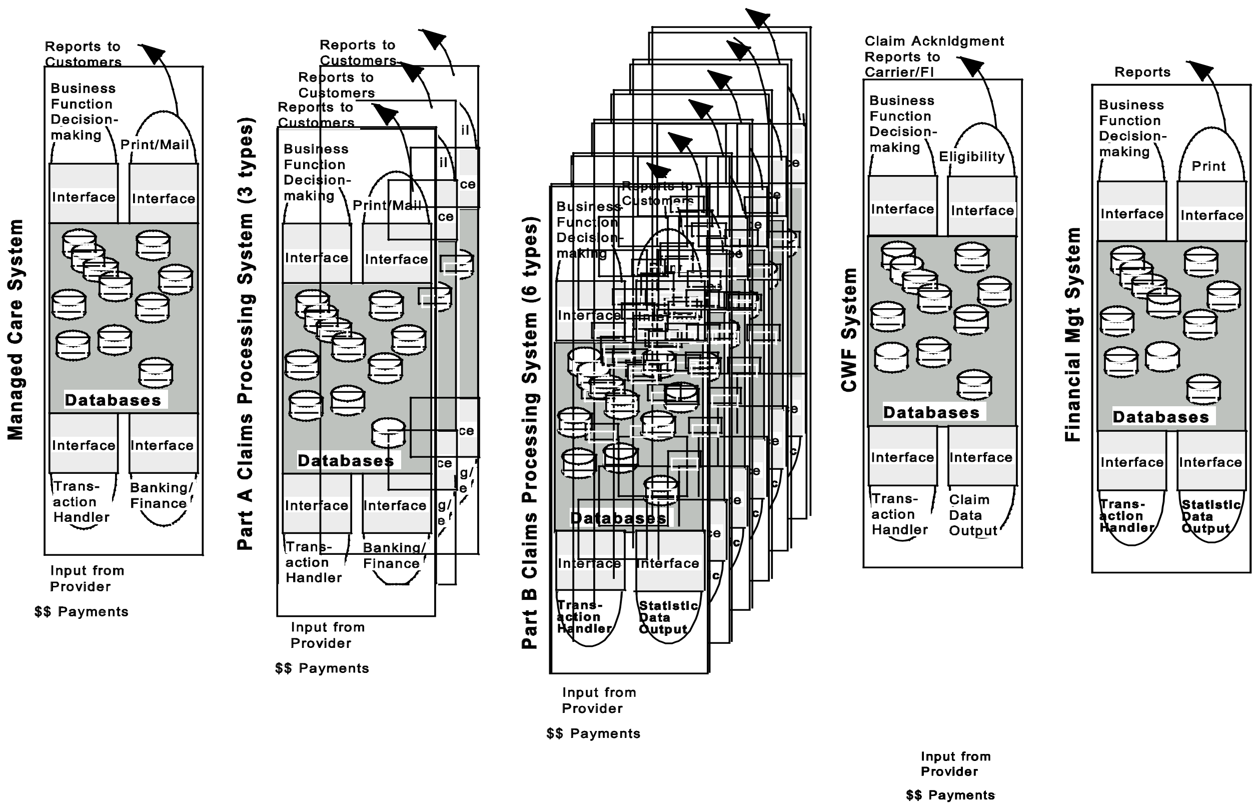


Figure 2. Business System-Oriented Architecture for Larger Medicare Programs. In this architecture each business function is represented by a separate monolithic (stovepipe) system. Databases are not shared, although much of the data accessed is identical to data used by other business systems. While each system is stand-alone, there is much replication of functions. Yet, as each system is managed independently by different business units, common system functions will diverge over time and the systems will be unable to communicate with each other despite their common origin. Nevertheless, systems are not truly separate because of interdependencies of replicated operational data.

When the Medicare program was being defined, Congress saw it both as expedient and efficient to build the program around the capabilities of commercial medical insurance companies, which already possessed the skillsets for reviewing and paying medical service claims, at the time mainly a paper-based activity. Thus, Medicare's claims processing infrastructure was early institutionalized as a collection of many independent and local claims processing centers. It was simply cheaper to make use of the contractors' already-developed individual claims handling processes and mechanisms rather than invent and require the use of "Federal" processes.

As automation became more available, each claims processor was essentially free to develop its own IT implementation to support and execute HCFA policy. From the beginning HCFA itself focused on policy analysis and contract management, leaving business operations, and thus most IT investment and planning, to the industry. The accepted model of the IT environment was of distributed and isolated systems that were not required to interact or intercommunicate, and that were allowed to develop independently of each other. With the HCFA systems being derived from many different commercial systems and claims processing models, the only common IT design thread was one of enforcing a common policy.

Unlike government, the motivators for businesses to embrace new technology are simple: reduce costs by deploying cheaper or more efficient means of production, and gain new capabilities that permit new profit-making activities. Driven by the possibilities of increased profitability, business willingly accepts the risks of promptly investing in new technology and invests in detailed project planning and monitoring to control risk. In contrast, governments have been extraordinarily conservative (risk averse) in the short term, relying upon rote compliance with detailed contract terms to control risk, and remaining relatively insensitive to the business possibilities of new capabilities. Government agencies often have difficulty changing course because of broad impacts they have on the economy and because of the risk of adverse public reaction. Continuing on the current path, however ill-suited to the business needs, is often perceived as representing the least risk. Change is at best incremental and but a small deviation from the current path, as the status quo is most easily defensible. Thus, current Medicare processing systems and HCFA central office IT infrastructure remain substantially similar to the technology implemented 10 to 15 years ago, despite operating on newer equipment.

Government legacy systems are large, monolithic, single-purpose software systems designed around "stovepipe" business functions. The software programs generally consist of millions of lines of aging COBOL code, (COBOL is a business programming language first developed in the fifties and sixties), were designed using decades-old hardware capabilities and software design concepts prevalent at the time, do not intercommunicate with other systems, run as batch (as opposed to interactive) processes, and are increasingly expensive and difficult to maintain because of the lack of adequate documentation and personnel skilled in the older language methods and programming styles. At HCFA Central Office, most of the systems are written in COBOL, but a significant fraction of the 17.6 million lines of systems code are written in the "Model 204" database language, a language that is now largely abandoned in the United States.

Current Capabilities, Future Needs, and the "Gap"

There are significant gaps between HCFA's current business needs and the performance of its current IT infrastructure. We will now briefly describe four categories of gaps, namely, the Flexibility and Availability Gap, the Performance Gap, the Maintenance Gap, and the Service Gap.

Flexibility and Adaptability Gap:

The current software infrastructure is increasingly difficult and expensive to maintain, much less expand to add new functionality to address new business needs. These systems were developed many years ago in languages in vogue at the time, to serve business needs strongly limited by the available technology. They have been incrementally modified over time, not to change the fundamental structure of the systems, but to add marginal capabilities and capacity. Further, the systems are inadequately documented. Even small changes are difficult, requiring substantial re-examination of the code and extensive testing to ensure that the changes do not propagate in unknown ways with unknown effects.

For life-cycle cost effectiveness the current HCFA software infrastructure needs to be more readily modifiable and adaptable. In its current legacy form, a major rebuild of a monolith may require 5 years or more. Because of short deadlines of mandated changes, as in the Balanced Budget Act of 1997 (BBA), and the short cycles of technological evolution, a response time on the scale of one year is necessary. Otherwise the enterprise is denied the benefits and potential savings of using improved technology and beneficiaries do not promptly receive the services of newly mandated programmatic changes.

Performance Gap:

The goal of deploying IT must be to leverage intellectual activity. Productivity gains permit more staff to be devoted to tasks that cannot be automated and that require more creative activity. HCFA's current business operations include many operations that rely excessively upon manual activity.

1) **Program Integrity:**

   Program Integrity seeks to ensure that only claims that provide health care value to the beneficiary are paid, and paid at proper rates. Current Medicare systems focus on correctness of individual claims, deferring most review for medical necessity and fraud, waste, and abuse (FWA) detection for more human intensive, and thus very expensive, post-payment analysis. FWA that occurs at higher levels of aggregation, such as collusion, “ping-ponging,” or bulk claim fabrication, is not readily detected by existing pre-payment processing mechanisms. The lack of significant pre-payment FWA detection forces HCFA to put undue reliance upon "pay-and-chase" methods. However, implementing the desired pre-payment FWA decision tools in the current environment requires that the data to support the decision tools be accessible interactively to those tools and that proven FWA detection algorithms be available.

The data to support such program integrity decision tools need to be global and timely. Currently, the National Claims History (NCH) database, HCFA's only global claims history database, does not contain all of the data needed for credible FWA detection, nor is the data it does contain readily accessible. More relevant information resides at contractor sites, in their local legacy environments; however, much of this information is lost when claim information is forwarded to the NCH. Most pertinently, claims were, until very recently, recorded as having been either paid or denied, but information as to whether the claim was determined to be FWA was not saved. Another failing is that "developed" or supporting information from review or investigations are not saved with the NCH claim record. Supporting record information, primarily in paper form, is kept only at the local contractor sites, and is accessible only for a short period before being archived in paper or microfilm.

By timely availability of information, we mean that all of the information relevant to the correctness of a claim be promptly available at its time of processing. In Medicare, a claim may be submitted as long as 27 months after the service was rendered. Closely related claims, as for a hospital stay and doctor visits to the patient in the hospital, may be received months apart, creating an environment ripe for abuse and fraud. Were this information available electronically and immediately upon the suspension of a questioned service claim, the claim might then be quickly adjudicated, perhaps in an automated or semi-automated way.

The data in the NCH is not readily accessible. A complex query against the NCH can require several months to process. This is because the database is a "flat file", consisting of many "one-line" claim records (all the information pertinent to one claim exists in one "line" in the file, requiring a linear read of every full record in the file to extract just the information of interest).

Although we have focussed here on the NCH as HCFA’s main repository of historical Medicare claim data, the situation with other HCFA program data is similar; data stores are not readily accessible to queries, the data may be incomplete or contain inconsistencies, and may not be up-to-date, hampering decision-making. Further, cross-correlation of information across different legacy systems is time-consuming and difficult.

2) **Policy and Decision Support:**

The goal of Policy and Decision Support is to provide timely answers to such questions as: What is the projectable cost of extending coverage to include acupuncture pain management for outpatient surgery? What health implications result from changing the allowed frequency of ESRD (End State Renal Disease) patient dialysis treatments to no more than once every 4 calendar days? Such questions are often asked during Medicare and Medicaid policy development, whether by HCFA policy staff, Congressional staff, State agencies, or university health care delivery researchers. As noted above, retrieval of raw data to generate statistics in order to answer such questions may take months. By the time the data is assembled, the interest and motivation that drove the question may have long ago faded. Worse still, delays in gathering the proper information results in delayed policy decisions that may negatively impact beneficiary health.

3) **Customer Service:**

Beneficiary requests for information or decision are handled both by Medicare contractors and at HCFA Central Office (CO) and Regional Offices (ROs). Queries range from what benefits are available to a particular beneficiary to requests from Congressional oversight committees for program statistical information. Response time to such inquiries is limited by the difficult access to stored information. ROs rely upon interactive data query support of CO databases. Simple queries, as of an individual beneficiary's eligibility status, may have sub-minute response times, while more complex queries; e.g., to support policy decisions requiring legislative action, may require up to several months. Because consumers are now accustomed to immediate response to their queries of the telephone company or airline reservation clerks, they reasonably expect similar responsiveness from government agencies. A second "gap" is in the amount and type of data securely accessible by beneficiaries using convenient kiosk, Web, and Internet tools, an area where HCFA lags far behind commercial entities.

Annually, HCFA CO receives over thirty thousand data requests. These range from requests for a single summary statistic, such as the frequency of a particular psychiatric procedure in a given metropolitan area to a fraud investigation request for all Medicare claims for a given specialty across a dozen States. Given legacy structures of current HCFA databases and their access control software, such requests may require weeks of expensive programmer time and consume significant data processing resources to satisfy. This programming effort is often committed to satisfying a one-time request; the software will never be used again. If adequate security controls were in place to ensure the protection of privacy and were the data accessible by standard database query languages, the requests could be made directly by the requester, and responded to automatically by the HCFA database infrastructure, without the necessity of time-consuming, complex, one-time programming efforts.

We can summarize the above discussion into four database performance gaps:

1) critical claim data is currently not all in one place but is physically widely distributed, hindering and delaying access,
2) data already in HCFA databases is not, in general, organized to be readily available in a timely way,
3) data that is available is not the necessarily the "right" data to support FWA, medical necessity, and policy making decisions, and
4) data is not readily or efficiently accessible from the databases that do exist.

Maintenance Gap:

A significant HCFA expense is the maintenance of its current software. Largely, the system programs are written in older computer languages, are structured for a batch-processing environment, are poorly documented or undocumented, and have been so patched that the original program coding design is no longer recognizable. Such applications are seldom as efficient as originally designed. When originally written, coding and data standards were probably non-existent. For example, a HCFA software system, such as the 1.3 million line Managed Care system, can have hundreds of data references to dates. Because such a large system has dozens of smaller program modules, written at various times by different staff, many of the date references may be, for example, to the same "date-of-first-eligibility" of a managed care plan, which are stored under a variety of different variable names, and in different formats. This creates a maintenance nightmare, as any changes to the system require that the specialist programming the change be knowledgeable about the details of the whole system in order that all references to a particular datum are updated. Much time is lost researching whether a single planned change might have undesired consequences. Modern programming methods and the adoption of data naming and reference standards can significantly reduce the life-cycle costs of software. Were such standard practices already in place, the resolution of the millennium problem would be simple and orders of magnitude less expensive.

Strategy for Closing the Gap

This IT strategic plan has two main thrusts: First, as Medicare and Medicaid today constitute some twenty per cent of the national expenditures for health care, it is vital that HCFA avoid any significant disruption in its processing and funding operations. Thus, a primary goal of the Agency must be on continuous, effective, and efficient operation. Recent legislation such as the BBA and Health Insurance Portability and Accountability Act (HIPAA) established new, time-sensitive expectations on HCFA, requiring it to add new services and products for its customers and to operate in more businesslike ways. Current operations must respond promptly to address urgent new and time-sensitive demands, even as HCFA works towards the target architecture.

Second, the very size and complexity of HCFA's IT enterprise demand a coherent long-range plan and vision if the enterprise is to evolve into a more efficient and capable operation. Computer, network, and communication technologies are evolving so rapidly that without careful long-range planning and implementation, the enterprise will not be able to take optimal advantage of new technologies, but rather will adopt technology haphazardly and in pieces that may not interoperate. Given the size, distribution, and critical nature of HCFA's program management and payment operations, software and communications demands are very complex. Thus, development projects for such IT resources are complex, require external advanced technical efforts to develop, and will require significant, dedicated financial, personnel, and managerial resources for their success. Coherency of the products, consistency with business needs, both current and future, and successful implementation mandate long-range strategic IT planning and investment. The Clinger-Cohen Act reinforces this simple but fundamental business need to operate with rational IT investment processes by giving directive and force of law as additional impetus. The strategic vision outlined in this document is HCFA's first step in performing this long-range IT planning process.

We have described above an Information Technology Vision that satisfies HCFA's business needs. Figure 1 is a picture that provides a high level, logical (as opposed to physical) architecture. The key elements of this picture are:

1) A central core of "well-managed" databases.
2) A structured interface that facilitates access to data in the core databases (this can be viewed as "middleware").
3) An assembly of modular application systems that manage infrastructure inputs and outputs, provide support for data operations (query, statistical analysis, data mining), and facilitate program operations.

This section lays out a strategy by which the Agency can migrate from the current legacy environment to an architecture that embodies the qualities of the target vision, namely, from the picture of business systems of Figure 2 to the picture of infrastructure of Figure 1. As discussed in the gap analysis above, the current environment cannot satisfy many of HCFA's current business needs. Thus, perpetuating the status quo is not a viable option; the legacy IT environment is not sustainable.

There is a spectrum of options for replacement of the current environment. At one end of the spectrum of replacement strategies is wholesale system replacement, i.e., discarding the current IT environment and replacing it with a completely new one. This approach assumes that little of the current system has lasting value, that the ability and substantial resources are available to effect an en masse reconstruction and replacement, and that the risks involved both in the construction of the new system and the transition from the old to the new can be adequately managed. Introduction of cutting-edge technology also carries its own risk, which we term technical risk. A prime underlying assumption of this approach is that the quick availability of the entirely new functionality is worth the up-front expense.

The other strategy extreme is a purely evolutionary and drawn-out piecemeal system replacement. This approach assumes that significant portions of the current structure have lasting value, that necessary resources will be available only over a long term, and that the cost of lost opportunity is not large. Because the pace of change is slower, the technical risk is small (by the time technology is fielded, it is no longer "new" but is well tested) and the capability requirements are lower. But if the infrastructure is already outdated, there is risk in being unable to quickly respond to changing business needs and to take prompt advantage of new and more efficient technologies. If the infrastructure is current and up-to-date, and is already modular with well-defined interfaces, evolutionary changes produce the most manageable risk profile. Testing is easier on smaller, less complex modules than on large, and using standard interfaces limits unpredictable ramifications.

The key elements in deciding upon an optimal approach from this spectrum are cost of the replacement, cost of perpetuating current system or system components while the replacement is in progress, time-value of new capabilities, complexity cost, technical risk, and program management risk (including political risk). In general, monolithic replacement is justified where the existing system is structurally limiting, as legacy systems generally are, because the existing foundations fail, sometimes catastrophically, under increasing operational demands. A purely evolutionary replacement approach functions well if the system is already modular and possesses highly defined interfaces; if aging modules can be replaced without causing unexpected disturbances or ripple effects elsewhere in the structure; and if modules can be relatively easily rearranged to form a new structure, allowing adaptability, because of the standard interfaces.

Given HCFA's current legacy environment on the one hand, and its pressing business need to readily implement new programs on the other, neither extreme is viable.

Within the broad range of intermediate courses, we must pursue a course that balances return against resource cost and risk. As the Agency's capability for managing significant system integration projects presents the most significant risk, we discuss this area next.

Implications of the MTS Project Outcome

Earlier this decade HCFA embarked upon a major IT development project called the Medicare Transaction System (MTS). This project was near the "wholesale system replacement" end of the IT replacement strategy spectrum. It envisaged replacing all the Medicare Part A, Part B, CWF, and Managed Care systems with a single centralized and integrated system. MTS conceptually was intended to address only the shortcomings of the current legacy Medicare claims processing environment; while it would have provided central databases that would have been incidentally useful in supporting other activities, its prime focus, as delineated in its name, was Medicare and OLTP processing. It would have eliminated duplicated functions, consolidated replicated databases into one central relational database and in only four years would have replaced the entire claims processing and payment environment with modern claims processing transaction processing hardware and software. It would also have established a separate data analysis environment to support statistical and policy development.

MTS was cost justified by net cost savings from greater claims processing efficiencies beginning after the fourth year. This was without foreseen (but unpredictable) savings due to reductions in fraud, waste and abuse that would have derived from enhanced data centralization and standardization. MTS was canceled because the project fell rapidly behind schedule and was significantly over budget. In hindsight, MTS as a project failed in its execution rather than in concept. HCFA had no experience in managing a project of such magnitude and failed to appropriately specify in the contract its real business needs and its constraints. The contractor, it can be argued, failed to accurately assess the project needs, substantially underbid the project, and did not employ the project management experience it possessed elsewhere in its organization. In short, capabilities were overestimated and risks and costs were significantly underestimated. To its credit, HCFA canceled MTS well short of the debacle status of many other large failed government IT projects.

While MTS was canceled before delivery of any software products, the project did produce some valuable results. First, the contractor worked extensively with HCFA in developing a set of business rules to define the project. The formal business rules for the Managed Care component were delivered on January 16, 1998. This systematic mutual review provided HCFA with perhaps the most comprehensive internal understanding of one of its major business operations since its inception. Second, significant design work was completed both at the contractor and at HCFA on key elements of an IT architecture that would have met many of the target system's design requirements. Third, HCFA learned a great deal about how to properly structure a major IT contract, what experience to look for in a contractor, and how to oversee and monitor system integrator contract progress.

Our MTS experience was especially valuable in effectively defining the upper limit of viable replacement strategies. Based upon HCFA's experience in managing major systems integration projects, replacement strategies of the scale of MTS currently exceed our capabilities. Now that we understand this crucial fact, we must look for another approach to meeting the still pressing business drivers which led to the original MTS strategy, and one that is capable of addressing HCFA’s larger business needs.

An intermediate approach reduces the project management risk by replacing not whole systems, but by replacing parts of systems. Thus, while outright replacement of the current managed care system (about one-sixth of MTS) can be seen as too large a project to successfully risk manage, a gradual replacement of managed care modules or subsystems should be within HCFA's capabilities. As HCFA's project management experience grows, larger and more complex replacement efforts will become credible. However, it must first demonstrate that it can reliably manage projects at the subsystem scale. This strategy thus builds Agency management capability for the future.

Sample Scenario for Staged System Replacement (Managed Care System)

To understand technically how this intermediate strategy should be designed and how it could work requires understanding the structure of a current legacy system and how it could be incrementally, or piecemeal, re-engineered until it could function as a replacement system in the new target environment. Clearly, to obtain the best return on investment, we need to perform a cost/benefit analysis to determine which systems would most benefit from early replacement, and focus our efforts on those options first. Some preliminary work on this has already been performed. Our analysis of the Managed Care (GHP) system is furthest along, and serves well to illustrate how this strategy would work. This same strategy equally well applies to all our legacy systems, including Medicaid systems like CLIA and OSCAR.

The GHP system, parts of which are over 10 years old, makes an appropriate first target for renovation for several reasons. First, a preliminary analysis of the GHP system suggests that it will become incapable of supporting anticipated growth in workloads within the next 2 to 3 years. Extra workloads, beyond normal growth, that are imposed by the planned implementation of various BBA provisions will further stress the system. Second, the GHP system is wholly owned by HCFA, operates at the HCFA data center, and HCFA staff are well familiar with its operation and code structure. This intimate understanding of this business system gives us greater confidence in our ability to plan and direct the renovation of this system, rather than, for example, one of the major, contractor maintained, legacy claims processing systems. Third, the MTS project provided us with a complete set of formal business requirements for a replacement Managed Care System, requirements based upon assumptions for a database-centric environment somewhat similar to that of Figure 1. Fourth, BBA imposes some new and time-urgent business requirements. Judicious choice of GHP subsystems to renovate, in a way that would allow them to be used intact in the replacement Managed Care System, would serve to increase the lifetime of GHP, satisfy some urgent BBA needs, and move us forward squarely on the path towards the target architecture. For these reasons, the Managed Care System warrants strong consideration as an initial renovation target. If we assume that the GHP system is the first of HCFA's major systems to be renovated, we are faced with developing an evolutionary path that will take us from the current legacy GHP system to a picture that is a forerunner of the "sunflower" representation of Figure 1 (which represents a further off, ultimate target). Before looking at a potential path, we will first examine the current system and the target system.

Figure 4 suggests what the eventual result of renovating GHP might look like. Business functions of the current managed care system, depicted in Figure 5, are present in Figure 4 not as integrated components of a monolith, but as decision-making modules that interface with the central database core. Certain BBA provisions and other business needs can be addressed by additional, independent petal modules that could handle new inputs, like encounter data, and new output functions, like the printing and mailing of individualized, customized beneficiary benefits booklets or the interactive data support for a 1-800-number beneficiary telephone service.

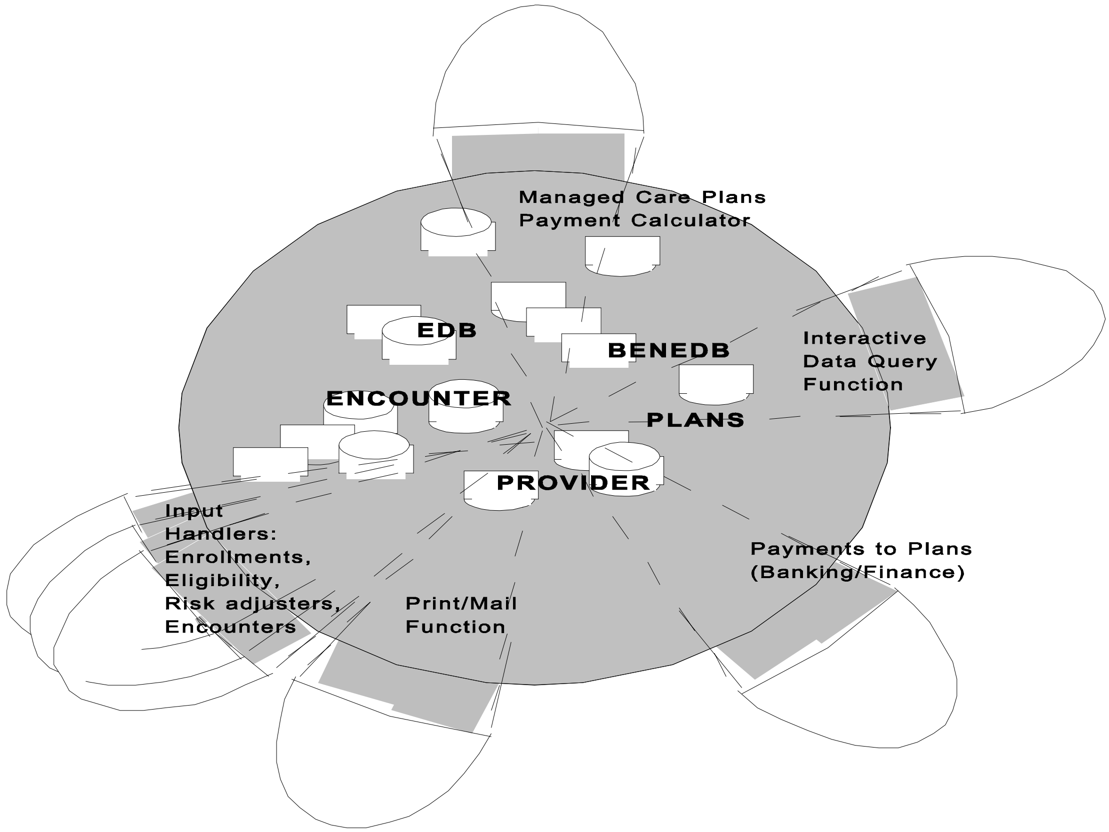


Figure 4. The "Sunflower" Model as it might appear after Phase 1.0 (Managed Care System Renovation).
A number of major databases comprise the data management core. Major databases will likely be:
EDB: Eligibility/Enrollment Database,
BENEDB: Database of beneficiary information (e.g., addresses, enrollment history),
PLANS: Database of MCO information,
ENCOUNTER: Database of encounter/claim information (similar to National Claims History or NCH DB),
PROVIDER: Database of provider information.
Through standard interfaces, all of these databases are accessible to the several business modules (sunflower petals) that perform the decision-making and input/output functions.

The Medicare + Choice consumer information required by the Balanced Budget Act serves as a useful example of how the new information-centric architecture can enable more effective and efficient program administration. Presently, consumer information must be drawn together in a labor-intensive manner. Rules are stored in policy memoranda and manuals and information about health plan options is stored in a variety of application-specific systems. Previous to the Balanced Budget Act, HCFA produced a “one-size fits all” handbook for all beneficiaries. The Balanced Budget Act requires this information to be tailored to local service areas that can be as specific as a zip code zone; it also mandates the availability of this information through additional channels. The organization of the rules and comparative information on health plan options in a centralized and well-managed database will facilitate the delivery of reliable, consistent and accurate information to beneficiaries through such sources as print/mail, 1-800 customer service, and the Internet.

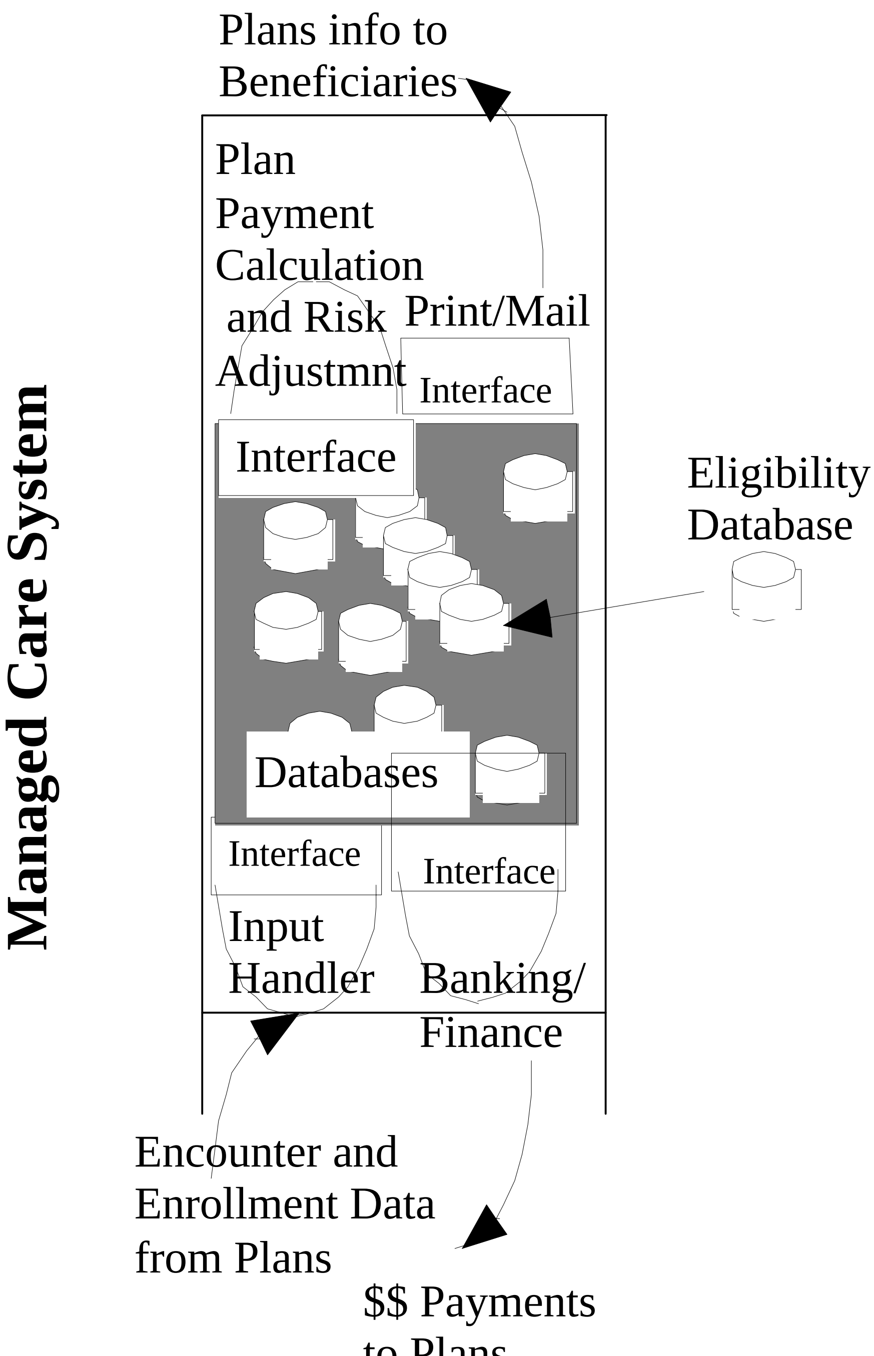


Figure 5. A Logical Depiction of the HCFA GHP Managed Care System.
This legacy system accepts input information from several sources, particularly beneficiary enrollment, disenrollment, and eligibility information, calculates payments to the Managed Care Plan Organization (MCO) in its business function decision-making component, handles various kinds of print/mail functions, both outputting information to the Plans and to the beneficiaries, and causes money to be transferred through the banking system to the Plans. The system as depicted appears as a monolith.

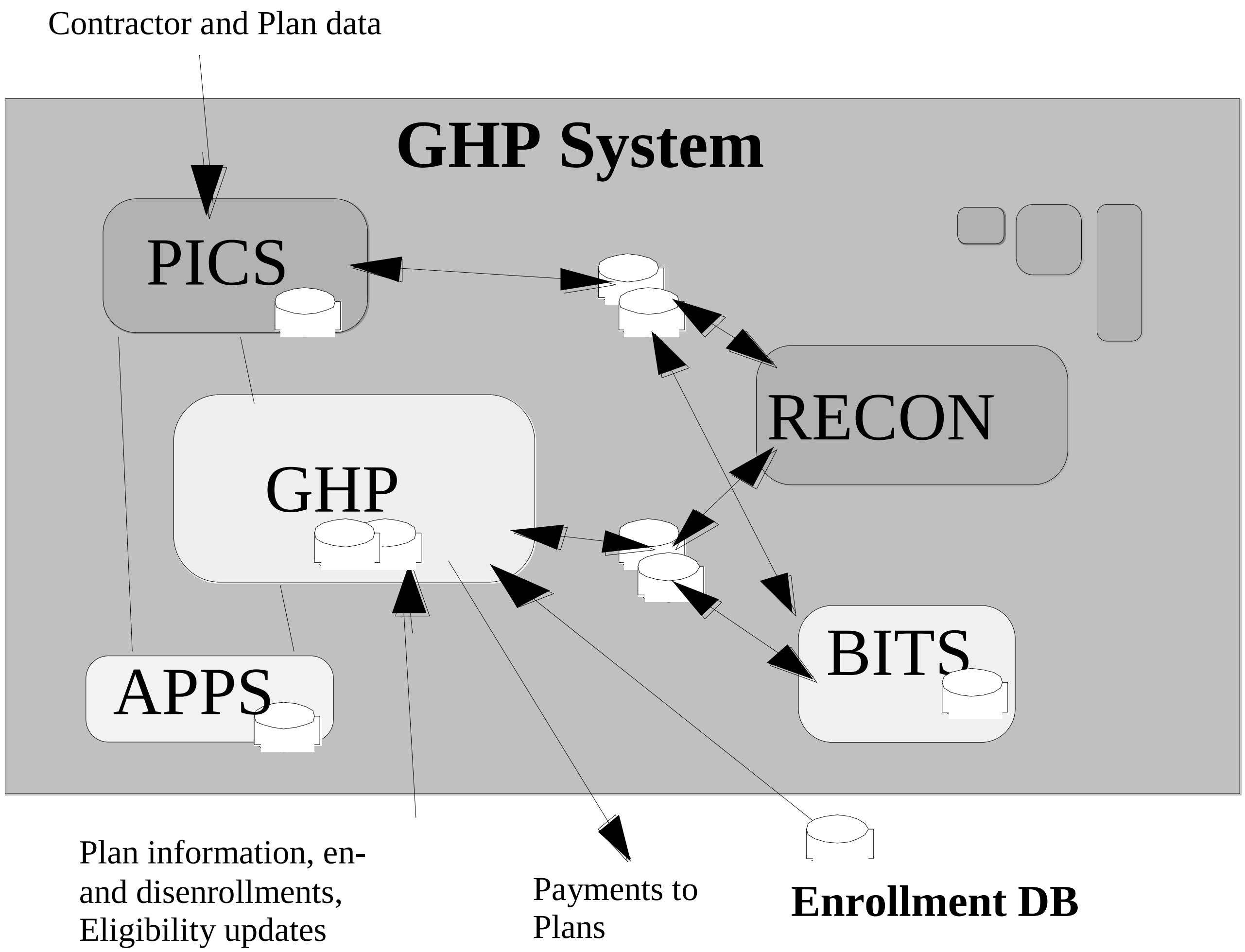


Figure 6. A Functional Depiction of the Current GHP Managed Care System.
The GHP (Group Health Program) system consists of five major and three minor subsystems, each serving different business needs. The major subsystems are:
PICS -- main repository of MCO Plan data
GHP -- main code structure: tracks enrollees, calculates all payments and adjustments
APPS -- accounting package, tracks summary plan payments
RECON -- tracks reconsiderations (beneficiary appeals of MCO denied services)
BITS -- controls and manages correspondence records

The heavy dark lines between modules represent direct data links. Arrows between subsystems and files (disk icons) represent communications by file transfers. Only the major communication paths are shown; many others exist. The major subsystems manage internal databases and perform calculations on that data. These subsystems comprise 1.3 Million lines of code in 804 programs. Seventy percent of the code is Model204 language, with nearly thirty percent COBOL and a small percentage of other languages. The subsystems are all interlinked through the data - e.g., to do enrollment, GHP has to verify (from PICS) that MCO has active contract; APPS must know how many beneficiaries are enrolled (from GHP) and that contract status is "pay" (from PICS). Because of all the data linkages, these subsystems are difficult to modify in isolation. The GHP system operates in two mutually exclusive modes, batch and interactive, at different times for different users. Batch runs nightly and on weekends to update enrollments and to perform payment calculations. Interactive operation is during the workday, to allow MCO Plans and Regional Office staff access to beneficiary and plan information.

Figures 5 and 6 give two different representations of the current GHP Managed Care System. Figure 5 is a high-level functional diagram; the functional diagram for the replacement system provided in Figure 4 contains all of the necessary pieces illustrated in Figure 5. Figure 6 provides more internal detail of the five major subsystems of GHP. There are additionally several smaller subsystems. In all there are over 800 identified programs and a number of critical databases supported in the GHP system. (A confusing bit of nomenclature is that the main GHP subsystem is also called GHP, requiring extra care in any discussion of the system.) For the purposes of this discussion, the critical piece of information is that when viewed up close, rather than a monolith, the GHP system appears as a collection of many different pieces, and it is the existence of this internal structure that provides the key to incremental renovation.

Any well-considered IT renovation decision must consider triage of the current infrastructure, namely, segregation into three categories: first, those components that are so outmoded that they must be replaced outright; second, those that are functioning well and require relatively little attention; and third, those that can be salvaged but require immediate significant attention. At the subsystem level of aggregation, we note that the various GHP subsystems and supporting databases have different functions and different characteristics. These components are not all aging at same rate, are not equally affected by BBA requirements, nor are they equally fragile, brittle or inefficient. In short, the subsystems and components do not all have same business urgency for replacement. Preliminary analyses of the system components, performed in support of normal maintenance activities, suggests that while some parts of the GHP system are very poorly suited for modern needs, other component parts of subsystems are well coded and might function well for some years.

Dual Track Strategy

As indicated above, HCFA is faced not only with long term business needs, but also with several current high priority business needs, such as year 2000 (Y2K) remediation and with implementing provisions of the BBA. Our renovation strategy makes use of triage to follow a dual track IT investment philosophy. For example, GHP is in need of structural renovation if it is to survive well into the future, but urgent BBA needs require solutions in a time frame that is shorter than permitted by either a monolithic rebuild or a gradual, evolutionary rebuild. By performing triage on the GHP system, we can focus our near-term IT investment on those components that can best support near-term needs, but unless absolutely necessary insist that any near-term component replacement or renovation be in a direction consistent with the ultimate target architecture. Renovation or modification to meet pressing near-term needs that does not move the IT infrastructure in the desired direction is not ruled out, but must be especially well thought out and justified as a near-term expedient action with a well supported return on investment (ROI). Such investments can be termed “throw-away” code, because they will have limited lifetimes, and can only be justified by exceptional ROI.

Triage at a subsystem component level thus becomes a very important tool for both the short-term and long-term tracks of our dual track strategy. For the short term, to address urgent business drivers, we must modify or replace those components that will either a) keep the current system operational until the replacement system is ready to handle the workload, or b) be necessary to support immediate business needs for new or modified capabilities (e.g., BBA provisions to support a one-call 800-number service). For the long term, triage is necessary to assess what modules and components need to be replaced outright, and what modules and components can be reutilized, either as is, or with renovation or modification.

It is essential in planning for the dual-track strategy to design-in flexibility in product modules and components by enforcing standard interfaces. This is necessary for two reasons. First, our vision of the ultimate target architecture must remain fuzzy, because the ultimate architecture is a moving target, always some years in the future. By building components modularly, with carefully defined interfaces (e.g., like Lego® blocks), if our target vision changes, the blocks will remain reusable despite the overall structure we are building changing with time. By building our architecture out of reusable modular components, with a consistent set of interfaces, like Lego® blocks, we can start out to build an apartment building, but as time goes on can rearrange the same structural blocks into an office building, if that is where our business needs and available technology direct us to go. Second, by using standard interfaces, we can use our newly constructed (or reconstructed) modules as replacement for the old functional components in our old stovepipe systems, and thus gain some improved reliability and efficiency in those systems, while we still proceed towards our target on the sunflower vision track.

By building, for example, a new database to house beneficiary information (e.g., BENEDB), using standard interfaces, that database will be usable long into the future. That same database can “plug” into the place occupied by a legacy beneficiary file in the existing system if we create a software “bridge” or “wrapper” to perform the translation between the new standard interface and the old interface used by the legacy system. Thus, we can enable the old legacy system to use the new database with minimum reengineering and expense. When the time comes to bring the new replacement system on line, the “bridge” software can be discarded.

Figure 7 shows a possible Gantt chart time line for a dual-track strategy for the replacement of the GHP Managed Care System. Both tracks begin with a detailed stress analysis of the current GHP system and its components. This analysis would permit triage of the current subsystems. The top-down analysis of business requirements for the Managed Care System could begin with the GTE final deliverable from the MTS project, supplemented with BBA business requirements. With the stress analysis, these business requirements could then be used to develop the technical requirements and the detailed project plan for the incremental build of the new Managed Care System. Scheduling early builds or renovations of certain of the components of the system could benefit the current GHP system, as these components could be embedded in “throw-away” wrappers to permit their use in the current system. The BENEDB and PLANS databases might be good candidates for these early builds for this reason. Eventually, enough components would become available to constitute the replacement system, and it would be ready for cutover from the current GHP system, which would then be retired.

Until the replacement system is prepared to assume the cutover workload, the GHP system must be maintained and kept operational. In the GHP track, the stress analysis would pinpoint those subsystems and modules that are the most brittle, and the most likely to fail under increased loads. These modules would be scheduled for in-place replacement (by early deliverables of the sunflower track) or for modification to improve the lifetime of the modules. Millennium remediation would have to be performed.

Many business decisions would need to be made in establishing a chosen path, and many different paths are possible. The path ultimately selected must depend upon finding appropriate returns on investment, which means evaluating a variety of alternative paths as to direct and lifetime costs, risk management, and technical feasibility.

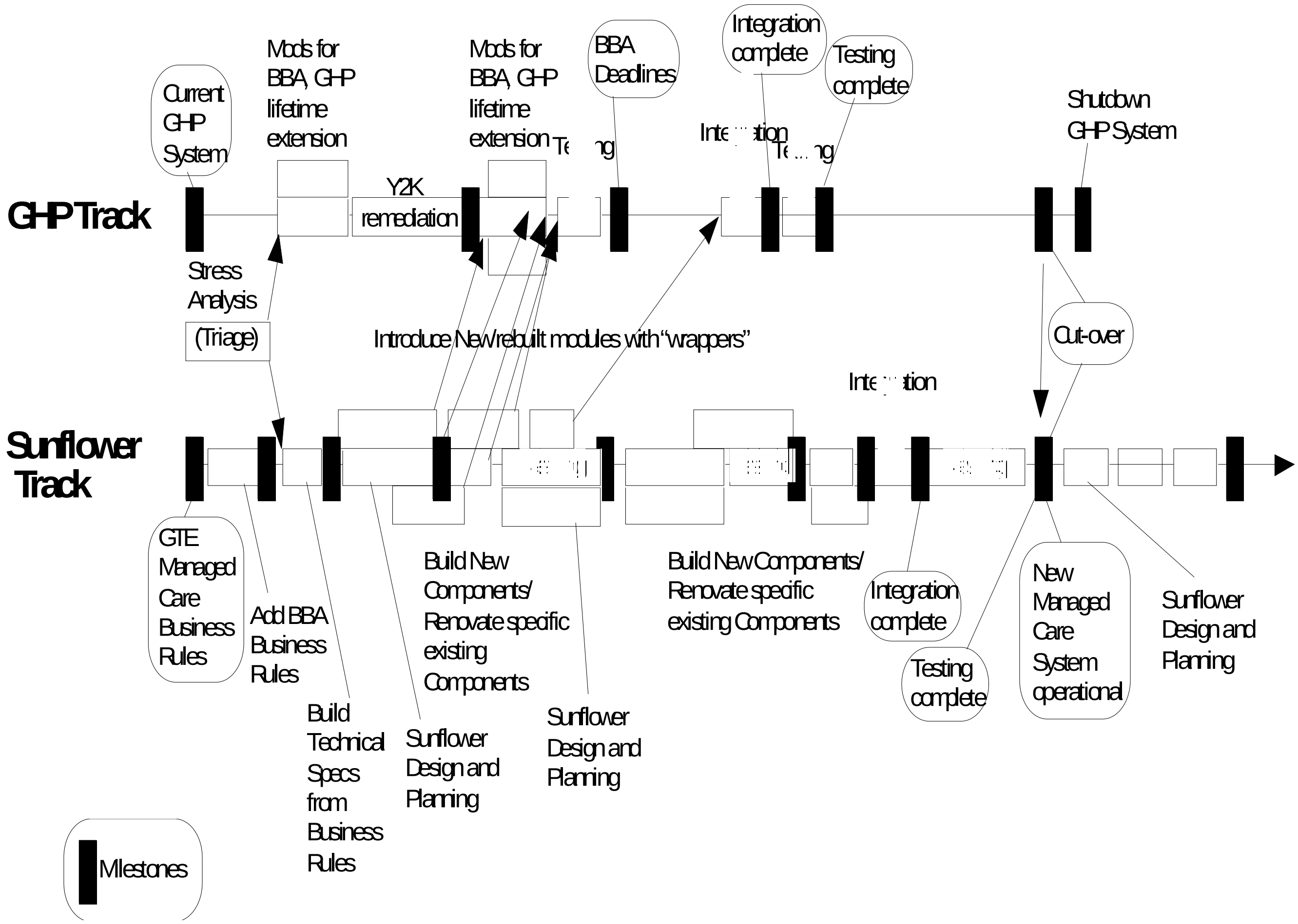


Figure 7. Schematic of a Possible Dual-Track Time line.
Dual-track strategy allows current system to function and to meet immediate needs while new system is being incrementally built. In this picture, time scale to complete new Managed Care functionality is approximately three years. Actual time scale and milestones would be determined from early studies, combining results of stress analysis and build of technical specifications. The frequent milestones and recurrent testing, as well as the modular and incremental software build philosophy derive from the IT investment strategy defined in Raines' Rules.

Note that a variety of major databases must be available for a renovated Managed Care System to function. Many, if not all, of these databases would ultimately be necessary to support the functioning of the other Medicare programs; e.g., the Part A and Part B claims processing systems. Thus, assembly of the core data management structure as part of the Managed Care System renovation would move the information infrastructure considerably along the path towards the target "Sunflower" architecture. With assembly of the data management core, renovations of other of the Medicare and Medicaid systems would be, overall, less effort than en masse renovation of their current stovepipe legacy systems. Figure 8 depicts a plausible overall strategy for achieving early phases of the target architecture.

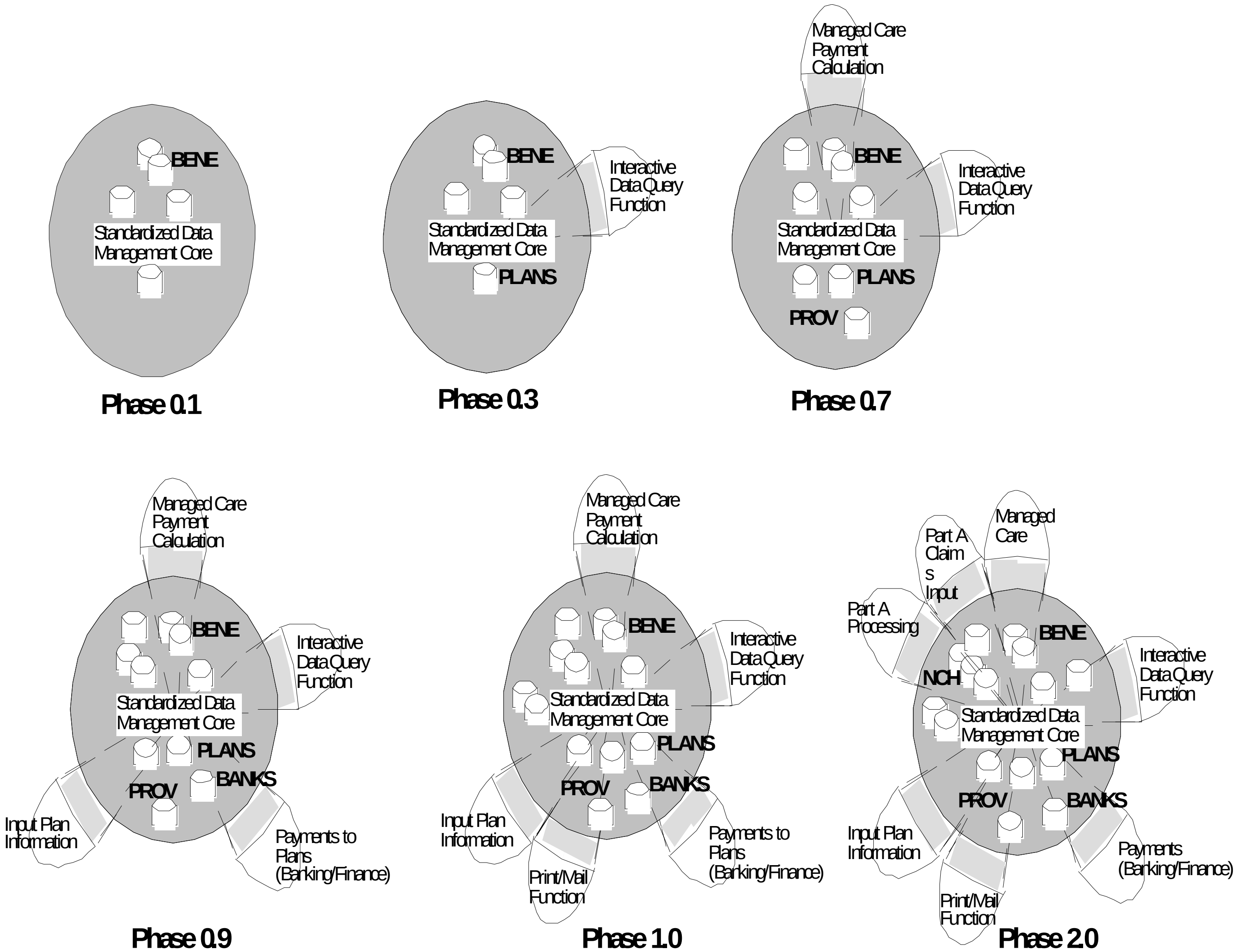


Figure 8. Strategy for Possible Path of Evolutionary Development of the "Sunflower" Architecture.
An incremental development of the "Sunflower" architecture can be envisaged as a staged development. Phase 0.1 might be construction of the first of the core databases, the Beneficiary database (BENEDB). Subsequent phases add increasing functionality (adding petals) and additional databases. Phase 1.0 could achieve replacement of the Managed Care System. Phase 2.0 might build upon Phase 1.0 to achieve replacement of the Part A claims processing environment.

Summary

This document has laid out a new vision for HCFA's IT infrastructure that is consistent with known and anticipated business needs. The “sunflower” vision stresses central well-managed information management at the core with modular decision-making systems readily accessing any necessary data in the core. The vision design encompasses prompt as well as broad access to data, high reliability, and “maneuverability” to provide flexibility to quickly respond to future needs and to future technologies. A key element of the vision design is that multiple plausible paths for achieving the target architecture exist. One potential path, addressing the needs of the Medicare Managed Care business component, is laid out using a dual-track strategy. The dual-track strategy allows for continued operation even as modernization and renovation efforts proceed towards the target architecture. The dual-track strategy permits the use of “throw-away" code, with a suitable interface so that renovated or new modular components can serve both current system needs and future reuse in the target environment.

The vision and approach described in this document differ significantly from earlier HCFA IT investment efforts. The major difference is primarily one of approach and methodology. Instead of focussing upon a direct replacement of a major business function, the strategy we describe here is intended to address the business needs of the whole enterprise, and to chose IT investments that optimally move the IT infrastructure towards goals that support all of the enterprise business functions. The strategy follows an overall risk averse approach, using incremental builds of highly structured code modules, standard interfaces, triage and object reuse where appropriate, and prudent project management processes. Frequent milestones and monitoring of project progress and deliverable quality with a variety of metrics are necessary to ensure successful development.

The sunflower vision represents a new IT goal for HCFA, that of an enterprise-wide evolutionary IT environment. The philosophy naturally embraces the structured IT investment strategy of the Clinger-Cohen Act and of Raines' Rules.